Atlantic Richfield Hanford Company
Richland, Washington 99352

ARH-2384

DESIGN CRITERIA DATA ACQUISITION SYSTEM FOR WASTE TANK LIQUID LEVEL GAUGES AND SX TANK FARM THERMOCOUPLES

By

G. E. Martin

and

R. G. Oliver

PREPARED FOR THE U.S. ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(45-1) 2130

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Process Systems Design and Development
Facilities Engineering Department
Chemical Processing Division

February 17, 1972

ATLANTIC RICHFIELD HANFORD COMPANY
RICHLAND, WASHINGTON

Operated for the Atomic Energy Commission by
Atlantic Richfield Hanford Company under Contract AT(45-1)-2130

DESIGN CRITERIA
DATA ACQUISITION SYSTEM FOR WASTE TANK LIQUID LEVEL GAUGES AND SX TANK FARM THERMOCOUPLES

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Atlantic Richfield Hanford Company	REVISION TO DESIGN CRITERIA	ARH-2384 REVISION NO. 2

TITLE: Design Criteria - Data Acquisition System for Waste Tank Liquid Level Gauges and SX Tank Farm Thermocouples

PROJECT NO.	DATE
HCE-671	Sept. 19, 1973

REVISION DETAILS

This design criteria revision (revision 2) will cancel revision 1 and will provide complete functional supervision of the liquid level gauges.

A new counter and an electronic supervisory circuit will be installed in each waste tank liquid level gauge. The electronic supervisory circuit will monitor (via the new counter and a signal from the gauge electronics) cycling of the gauge on a one minute time cycle. This supervisory circuit will fulfill the intent of revision 1 (monitor AC power to the gauge) and, in addition, will supervise all other aspects of the gauge including: the electronics, the drive motor, all sprockets and chain linkages, and the counter. If a gauge failure should occur, this circuit will remove the +12 volts excitation from the data acquisition system interface board; and the computer will be programmed to recognize this condition as a gauge failure.

REASON FOR REVISION

At the present time if a liquid level gauge was to fail (either through a component failure or loss of AC power), it would stop operating; the plummet would be held at one position (level); and the condition would not be recognized by the computer. If the tank was to start leaking when the gauge was in this condition (not operating), the drop in liquid level would not be detected.

EFFECT ON COST AND SCHEDULE

The cost of the project will be increased by an estimated $32,700.00. This revision will extend the completion of this project by an estimated 4 months. However, the revision does not effect the scheduled "start-up" date of the data acquisition system, since it will operate normally without the proposed revision.

REQUESTED BY	DATE	APPROVED FOR ARHCO	DATE
R. G. Oliver	9-19-73	[signature]	9/19/73
SUBMITTED BY	DATE	APPROVED FOR AEC-RL PROGRAMS DIVISION	DATE
R. G. Oliver	9-19-73	[signature]	10/17/73
☐ MANUFACTURING	DATE	☐ PROJECT MANAGEMENT	DATE
[signature]	20 Sept 73	[signature]	9/20/73
☐ OPERATIONAL SUPPORT ENGINEERING	DATE	☐ PERSONNEL PROTECTION	DATE
[signature]	9-20-73	[signature]	9/26/73

A-6400-083 (1-73)

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Facilities Engineering Department
Chemical Processing Division

February 17, 1972

This document has been reviewed and approved as a basis for project action.

Submitted:

W P Ingalls — 3-2-72

Manager - Process Systems Design & Development — Date

Approved:

— 3-3-72

Facilities Engineering Department
Atlantic Richfield Hanford Company — Date

Approved:

— 3-23-72

Richland Operations Office
U. S. Atomic Energy Commission — Date

DESIGN CRITERIA
DATA ACQUISITION SYSTEM FOR WASTE TANK LIQUID LEVEL GAUGES AND SX TANK FARM THERMOCOUPLES

I. INTRODUCTION

Seventy-seven (77) nonboiling waste storage tanks located in the 200 East and 200 West Areas are currently being equipped with continuous reading, liquid level gauge heads by Project HCE-665. When the project is completed, each gauge will provide a continuous liquid level reading at its respective tank site and will require that an operator travel from tank to tank to record the liquid level readings. The information obtained with these gauges will be used for leak detection and inventory control purposes.

In the SX Tank Farm in the 200 West Area, seven waste storage tanks are currently being utilized as sludge-cooling tanks. The sludge in these tanks contains a high concentration of Sr-90, is self-heating and, therefore, must be air cooled and kept under constant surveillance. At the present time, the temperatures within these tanks (sludge and vapor space temperatures) are monitored by 231 thermocouples (33 per tank). Once per day an operator manually reads and records data from each of the 231 thermocouples.

In both of the above mentioned systems, the data, upon being collected, must be analyzed and compared with prior data. This method of data collection and evaluation is slow, expensive, and subject to error.

In view of the importance of minimizing the loss of radioactive wastes to the environment and damage to waste storage tanks, a system is required that will rapidly and frequently scan all liquid level gauges and thermocouples, analyze the data, and alarm in the event of an abnormal condition.

II. PURPOSE

The purpose of this document is to set forth the design criteria for the installation of a data acquisition system (DAS) which will interface seventy-seven (77) waste tank

liquid level gauges and two hundred thirty one (231) waste tank thermocouples to the existing IBM 1800 computer located at the Purex Plant.

III. DESIGN CRITERIA

A. General

This data acquisition system (DAS) shall interface the liquid level gauges and thermocouples, shown on drawings SK-2-22273 and SK-2-22274, to the IBM 1800 computer located at the Purex Plant. The system shall have two (2) switch selectable modes of operation. In one mode, the computer shall have complete control of the system. In the second mode, control shall be provided by local control stations (two required), completely independent of the computer. This second mode of operation will allow the data points to be scanned and printed out even though the computer is "down" and, in addition, will be an aid in troubleshooting and calibration.

B. Installation Description

The DAS shall be partitioned into two (2) sections - the West Section and the East Section. The West Section shall monitor the liquid level gauges and thermocouples located in the 200 West Area. The East Section shall monitor the liquid level gauges located in the 200 East Area. For each section of the DAS, there shall be a central station. The central station shall provide the interface between the computer and the data points within that section. The central station shall also serve as the local control station and as such shall have controls to select the mode of operation and a printer to print out the data points within that section. In the West Section, the central station shall be located at the 241-SX-271 Building. In the East Section, the central station shall be located at the most convenient location for the type of equipment procured. The East Central Station shall be wired directly into the computer, and the West Central Station shall be wired to the computer via one or two pair of dedicated telephone lines. The lines may be terminated at the East Central Station or at the computer. The distance between the West Central Station and the computer is approximately 6 miles.

Within each area the liquid level gauges shall be divided into groups as follows:

West Area

Group T - all liquid level gauges in T Farm

Group TX - all liquid level gauges in TX & TY Farms

Group U - all liquid level gauges in U Farm

Group SX - all liquid level gauges in S and SX Farms

East Area

Group B - all liquid level gauges in B Farm

Group BY - all liquid level gauges in BY & BX Farms

Group C - all liquid level gauges in C Farm

In each area, wiring shall be routed overhead from group to group and to the central station utilizing existing poles where possible. Within each group, conduit (installed on Project HCE-665) has been routed from each gauge head to a point where the substation shall be located. The substation shall provide the inter-tie point between the underground lines within a group and the overhead lines between groups. The hookup wire between the gauge head and the substation shall be sized to be pulled through the existing conduit. See drawings SK-2-22273 and SK-2-22274 for details.

The thermocouple leads are presently brought into the 241-SX-271 Building. A thermocouple multiplexer shall be located within this building and wired directly into the West Central Station.

C. Equipment Description

The DAS shall meet the following criteria:

1. The output of each liquid level gauge is a rotating shaft which is presently connected to a mechanical counter. As part of the DAS, a transducer shall be supplied for each gauge head, which will operate in conjunction with the existing counter or replace

it with a similar local readout with at least four (4) digit resolution. The transducer assembly shall be fabricated to fit into the gauge head enclosure and require a minimum amount of effort to install in the field.

2. The accuracy of the gauge head transducer shall be at least 0.1 inch. The transducer shall be the least accurate part of the DAS.

3. The number of wires required to connect a gauge head transducer to the DAS shall not exceed 6 pairs (12 wires).

4. The number of wires required in the overhead runs shall not exceed 6 pairs (12 wires).

5. The gauge head transducer shall not require recalibration after a power failure.

6. The DAS shall not require batteries.

7. The thermocouple multiplexer shall have provisions to accept 231 iron-constantan thermocouples. The temperature range shall be 50-400°F. The accuracy shall be $\pm$ 2°F or better.

8. The DAS shall be capable of operating in two modes:

   a. Computer controlled scan of a single point, group of points, or all points with the information being processed by the computer.

   b. Locally controlled (independent of the computer) scan of a single point, group of points, or all points with the information being printed out in engineering units (inches and degrees Fahrenheit) by a local printer.

9. The transducers and substation components must operate within specifications over a temperature range of -20°F to 140°F. All remaining components of the DAS must operate within specifications over a temperature range of 40°F to 100°F.

10. The only power required by the DAS shall be 115VAC ± 15%.

11. Each substation shall consist of a wall mounted, dust proof enclosure with all components mounted inside.

D. Standards and Codes

The Hanford Engineering Standards, including the Standard Design Criteria and AEC Manual Chapter Appendix 6301, are to be utilized, where applicable, in the design of the facilities and equipment specified herein.

E. Quality Assurance

A Quality Assurance Program shall be established and adhered to throughout design, construction, and testing. This program shall assure that the data acquisition system, described by these criteria, will perform as described in a safe and reliable manner.

Quality assurance for design, inspection, and testing shall be in accordance with the plans as outlined in the Vitro Engineering Services Quality Assurance Program, reference 1. Quality assurance for construction performed by the on-site fixed fee contractor, J. A. Jones Construction Company, shall be in accordance with the plans outlined in the J. A. Jones Construction Company Quality Control Manual, reference 2. If construction is performed by a fixed price prime contractor, a quality assurance plan similar to the J. A. Jones Construction Company Quality Control Manual shall be submitted by the contractor and approved by the customer.

Three categories have been established for classifying structures and components according to the degree of quality required by safety considerations for system designs. These categories are defined as follows:

Type A

Those structures and components whose failure might cause or increase the severity of a release of radioactivity, hazardous or toxic material to the environs; or those structures and components vital to the safe shutdown of the process or system.

Type B

Those structures and components which are important to the operation of the process or system, but are not essential to its safe shutdown and isolation.

Type C

Those structures and components that are related to the process or system operation, but are not essential to safe shutdown and isolation and provide only a service to the facility.

The data acquisition system covered by these criteria is classified as quality assurance category Type B.

IV. REFERENCES

1. Vitro/HES-MA-1, unclassified, November 1, 1971, "Vitro Engineering Quality Assurance Program"

2. J. A. Jones Construction Company, unclassified, October 14, 1971, "Quality Control Manual"